DOCUMENT RESUME

ED 208 008 TM 810 689

AUTHOR	Chromy, James R.; And Others
TITLE	Year 11 Primary Sample for the National Assessment of Educational Progress. Final Report.
INSTITUTION	Research Triangle Inst., Research Triangle Park, N.C. Center for Sampling Research and Design.
SPONS AGENCY	Education Commission of the States, Denver, Colo. National Assessment of Educational Progress.; National Center for Education Statistics (ED), Washington, D.C.; National Inst. of Education (ED), Washington, D.C.
REPORT NO	RTI-1764-00-00F
PUB DATE	Aug 81
CONTRACT	OEC-0-74-0506
GRANT	NIE-G-80-0003
NOTE	73p.
EDRS PRICE	MF01/PC03 Plus Postage.
DESCRIPTORS	Asian Americans; Computer Programs; *Educational Assessment; Elementary Secondary Education; Hispanic Americans; *National Competency Tests; Research Design; *Sampling; Testing Problems; Testing Programs
IDENTIFIERS	*National Assessment of Educational Progress

ABSTRACT

The primary sample for Year 11 of the National Assessment of Educational Progress (NAEP) was selected in March 1979, and was preceded by an 18-month planning effort. During the planning period, research concentrated in five specific areas: sampling frame construction, stratification criteria, efficiency study review, techniques and computer software for highly stratified sample selection, and sampling for Asian and Hispanic populations. Primary samples from the first ten years are reviewed, and the sampling frame construction is discussed. The actual selection of samples, the sample stratification, options for large and small annual samples, selection techniques, and sampling for special populations are discussed. Primary type of information provided by report: Procedures (Sampling). (Author/BW)

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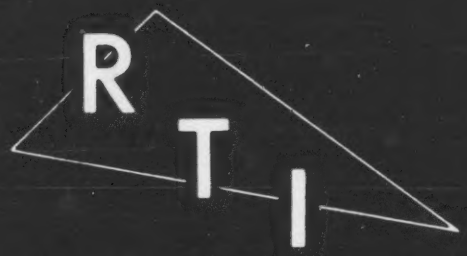

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RTI/1764/00-00F

Final Report

YEAR 11 PRIMARY SAMPLE FOR THE NATIONAL ASSESSMENT OF EDUCATIONAL PROGRESS

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TM 810 689

Prepared for

National Assessment of Educational Progress

August 1981

TABLE OF CONTENTS

		Page
1.	INTRODUCTION	1
	1.1 Planning Period Activities	1
	1.2 Sample Overview	2
	1.3 Report Organization	4
2.	TEN YEARS' PRIMARY SAMPLES	6
	2.1 Common Elements	6
	2.2 Differentiating Elements	11
	2.3 Summary Characteristics	18
3.	SAMPLING FRAME CONSTRUCTION	22
	3.1 Sampling Frame Units	22
	3.2 Sampling Frame Variables and Data Sources	22
	3.3 Editing and Verification Procedures	34
4.	STRATIFICATION	36
	4.1 Overview	36
	4.2 Sample Allocation by Region and SDOC Category	39
	4.3 Meeting the All-State Requirements Over a Four-Year Period	40
	4.4 Selecting the Sample	43
5.	OPTIONS FOR LARGE AND SMALL ANNUAL SAMPLES	53
	5.1 Primary Sample	53
	5.2 Secondary Sample	54
6.	SELECTION TECHNIQUES	57
7.	SPECIAL POPULATIONS	58
	REFERENCES	67

LIST OF TABLES

Table		Page
2-1	National Assessment Reporting Categories	7
2-2	Definitions of National Assessment Regional Subpopulations	8
2-3	Summary Characteristics From First Ten NAEP Samples . .	19
4-1	Sample Allocation by Region and SDOC Categories	41
4-2	Allocation in Terms of 1-, 2-, and 3-Replicate Units. .	42
4-3	Five-Sample Allocation by Region, State, and SDOC . . .	44
4-4	Serpentine Ordering of States Within Region	46
4-5	Illustration of Serpentine Ordering of Sampling Frame .	48
4-6	Assignment of Selected Units to Years	52
5-1	Partitioning Supplemental Samples into 4 Subsamples . .	55
5-2	Numbers of Schools per Replicate and per PSU for Each Option	56
7-1	Weighted Estimates of Minority Population From 4-Year Primary Sample	60
7-2	Weighted Estimates of Minority Populations by Region and SDOC for Year 11	61
7-3	Weighted Estimates of Minority Populations by Region and SDOC for Year 12	62
7-4	Weighted Estimates of Minority Populations by Region and SDOC for Year 13	63
7-5	Weighted Estimates of Minority Populations by Region and SDOC for Year 14	64
7-6	Weighted Estimates of Minority Populations by Region and SDOC for Supplemental Year 14	65
7-7	Weighted Estimates of Minority Populations by Region and SDOC for Frame	66

1. INTRODUCTION

This report is submitted to the National Assessment of Educational Progress (NAEP) and constitutes the final report for the coordinated four-year primary sample commencing in Year 11. The sample was selected in March 1979 and was preceded by a 18-month planning effort. During the planning period, primary designs from the first ten years were examined in terms of strengths and weaknesses, design efficiency studies conducted in Year 07 were re-examined, and direction of the sample over the next four years was discussed.

1.1 Planning Period Activities

During the planning period, research concentrated in five specific areas each of which are discussed below.

1.1.1 Sampling Frame Construction

A minimum set of variables to be included on the sampling frame was developed and additions were made as appropriate. All sampling frame information was organized at the 1970 Census-defined county level. The final set of variables is discussed in Chapter 3.

1.1.2 Stratification Criteria

Stratification criteria used in previous assessments were reviewed. Potential stratification variables related to region, race or ethnicity, community characteristics, and occupation were included on the sampling frame. The existence of the sampling frame and various stratification variables permitted the testing of different stratification and sample selection strategies.

1.1.3 Efficiency Study Review

Variance component estimates from the Year 07 design efficiency studies were re-examined. The sample design planned for year 11 was found to be generally consistent with the findings of the efficiency study and the special requirements of NAEP for domain estimation.

1.1.4 Techniques and Computer Software for Highly Stratified Sample Selection

The final product of this research was the computer software required to order listing units in a serpentine fashion and form equal sized zones from which one unit was selected. The stratification and zone formation techniques are detailed in sections 4.4.2 and 4.4.3, respectively. The sample selection process is discussed in Chapter 6.

1.1.5 Sampling for Asian and Hispanic Populations

Appropriate 1970 Census data useful for identifying Hispanic or Asian populations in primary sampling units composed of counties were included in the sampling frame data set.

An alphabetic list of Spanish surnames was obtained from the Bureau of the Census. The list could be used to identify and oversample Spanish students in schools. No comparable list existed for Asian names. Spanish surname identification procedures were pretested at six school locations during quality check visits. Generally favorable results were reported.

Specific sampling procedures adopted for special populations are discussed in Chapter 7.

1.2 Sample Overview

The National Assessment sampling design is a three-stage stratified probability sample. Stratification variables include region, community

size, and socioeconomic status. The selection of the primary sample is only the first step in the process. An overview of the general sampling and weighting process is included here for completeness and reference.

The National Assessment sample is designed to be representative of students in three age classes, 9-, 13-, and 17-year-olds, in all schools and communities in the nation. It is also designed to produce, for a variety of subpopulations, performance estimates which are relatively unbiased and which meet certain precision requirements.

Primary Sampling Units (PSUs) are geographic land areas consisting of a single county or several counties. Each year approximately 83 PSUs are randomly selected on a probability basis so that every county and every state in the United States has a positive chance of being included in the sample.

At the second stage of sampling, a list of all schools, both public and private, within each of the selected PSUs is developed and a probability sample of these schools is selected for each of the three age classes. The number of schools selected in each PSU is determined by the approximate number of students in the eligible age group attending each school. Schools are selected in such a way that any given school will not appear in the sample more than once in a four-year period. In most years, about 1,600 schools are selected; the number selected in a particular year depends upon the number of distinct packages.

The third and final stage of sampling is the selection of a random sample of students from the eligible age group at each selected school. A total of approximately 2,600 respondents is obtained for each National Assessment package. Generally, the students are selected from one to eight

schools within each selected PSU for each of the three age groups being assessed.

Selected students who do not show up for assessment are termed nonrespondents. Response rates for 9- and 13-year-olds tend to average about 85 percent, whereas the response rate for 17-year-olds averages 75 percent. Seventeen-year-olds who miss their appointments are followed up in school the day after the assessment. Seventeen-year-old dropouts and early graduates are located in their homes and administered packages. According to census data, about 10 percent of the 17-year-olds are not enrolled in school. Including these out-of-school individuals in the target population enables National Assessment to apply its results to the entire population of 17-year-olds rather than only to those enrolled in school. The assessment of dropouts and early graduates is termed the Supplementary Frame assessment.

Sample weights adjusted for nonresponse are computed for each age class. The weights are calculated as the reciprocal of the appropriate selection probabilities. Sample weights are used to calculate ratio estimates of the proportions of population members who respond in alternative ways to assessment exercises. So that the proportion of population members who respond in alternative ways can be calculated based on community location and occupation of parents, the assessment data are postclassified into seven size and type of community (STOC) categories.

1.3 Report Organization

The primary sample planning period activities are reviewed in the initial chapters. Primary samples from the first ten years are reviewed in Chapter 2, and the sampling frame construction is discussed in Chapter 2.

The actual selection of the sample is discussed next; the sample stratification, options for large and small annual samples, and selection techniques are detailed in Chapters 4, 5 and 6, respectively. Sampling for special populations are discussed in Chapter 7.

2. TEN YEARS' PRIMARY SAMPLES

In the sections which follow, the primary samples from the first ten years of the National Assessment of Educational Progress (NAEP) are compared. Similarities are cited in section 2.1 while differences are noted in section 2.2. A summary of the characteristics from each year's sample is provided in section 2.3.

2.1 Common Elements

National Assessment reports results for a variety of subpopulations. Besides the three in-school age groups, reported subpopulations include within each age level four geographic regions, sex, race, grade, four levels of parents' education, and seven size and type of community (STOC) categories. These reporting groups are listed in table 2-1.

A major objective of the National Assessment survey design is to guarantee adequate sample representation for the reporting subpopulations listed in table 2-1. Such representation is essential if reasonably precise comparisons among these subpopulations are to be made within a given assessment year and with previous years when the same subject areas were assessed. For these reasons the primary samples for the first ten years have always included stratification by region and community and oversampling of low socioeconomic subpopulations. These three topics are discussed in the sections which follow.

2.1.1 Stratification by Region

The geographic regions referred to in table 2-1 are those used by the Office of Business Economics, Department of Commerce. Table 2-2 defines NAEP's regions in terms of the sets of States which comprise the four geographic areas. Consistently in Years 01 through 10, this same set of regional strata has been used.

Table 2-1. National Assessment reporting categories

Classification	Number of subgroups	Subgroup names
Age level	3	9-, 13-, 17-year-olds
Sex	2	Male, Female
Race	4	White, Black, Hispanic, Other
Geographic region	4	Northeast, Southeast, Central, West
Level of parental education	4	No high school Some high school Graduate high school Post high school
Size and type of community (STOC)	7	Low metropolitan (extreme inner city) High metropolitan (extreme affluent suburb) Extreme rural Main big city (remainder of big city) Urban fringe (suburban fringe) Medium city Small places (small city)
Grade	3 (9's,13's)	3,4, Other 7,8, Other
	4 (17's)	10,11,12, Other

Table 2-2. Definitions of National Assessment regional subpopulations

Northeast	Southeast
Delaware	Arkansas
Connecticut	Florida
Maine	Virginia
New Hampshire	West Virginia
Rhode Island	Alabama
Vermont	Georgia
District of Columbia	Kentucky
Maryland	Louisiana
Massachusetts	Mississippi
New Jersey	North Carolina
Pennsylvania	South Carolina
New York	Tennessee
Central	**West**
Iowa	Alaska
Kansas	Hawaii
Nebraska	Idaho
North Dakota	Montana
South Dakota	Nevada
Minnesota	Wyoming
Missouri	Arizona
Illinois	Oregon
Indiana	Utah
Michigan	Colorado
Wisconsin	New Mexico
Ohio	Oklahoma
	California
	Texas
	Washington

2.1.2 Community Stratification

In order to insure proper sample representation in the seven STOC categories, community stratification must occur at the primary sample selection level. The form of community stratification has varied from year-to-year. In Year 01, areas within a county were classified. In all successive years, classification has been at the county-level. There were four types of community classifications in Year 01. They included:

Large central cities;

Fringe areas of the large central cities;

Middle sized cities; and

Rural and small town areas.

In Years 02 and 03, four precise county-level size of community (SOC) definitions were developed in terms of 1960 Census data:

SOC1 - all counties containing a central city with a population of 180,000 or more,

SOC2 - all counties in the same Standard Metropolitian Statistical Area (SMSA) as SOC1 county,

SOC3 - all counties not included in SOC1 or SOC2 that are either a part of an SMSA or that contain at least one city with a population of 25,000 or more,

SOC4 - all counties not included in SOC1, 2, or 3.

In Years 04 through 10, SOC was defined in terms of 1970 Census data. The Year 04 definitions were similar to Years 02 and 03 except (1) the size of the central city required to define SOC1 was increased from 180,000 to 350,000 and (2) SOC2 also included all counties with a central city of 150,000 to 350,000 population.

In Year 05, to facilitate stratification of the school sample along size and type of community lines, SOC was defined to include entire 1970

SMSAs. SOC1, 2, and 3 consisted of entire SMSAs and SOC4 and 5 were non-SMSA counties:

SOC1 - the largest 15 SMSAs based on adjusted 14-year-old population (self-representers);

SOC2 - the remaining 55 SMSAs with total population in excess of 500,000;

SOC3 - the remaining 162 SMSAs.

SOC4 - non-SMSA counties with 60 percent or less of their 14-year-old population classified as rural in the 1970 Census;

SOC5 - non-SMSA counties with more than 60 percent of their 14-year-old population classified as rural in the 1970 Census.

SOC4 and 5 were defined to include about equal numbers of 14-year-olds in 1970. Fourteen-year-olds in 1970 would be aged 16 in 1974 when Year 05 assessment was conducted. The closest to 17-year-old single age reported by urban and rural classification on the 1970 Census data tapes was 14-year-olds. The Year 06 definitions were very similar to Year 05 except (1) Denver and Phoenix were removed from SOC2 and added to SOC1 as self-representers and (2) SOC4 and 5 were defined in terms of non-SMSA primary units rather than counties. SOC4 consisted of those primary units with less than 65 percent of their 14-year-old population classified as rural in the 1970 Census. SOC5 contained those units with 65 percent or more of their 14-year-olds classed as rural.

The Year 06 definitions continued to be used in Years 07 through 10.

2.1.3 Oversampling of Low Socioeconomic Subpopulations

NAEP reports results for 7 STOC categories (see table 2-1.) In order to accurately report results for the first 2 categories, low socioeconomic subpopulations in the large cities and rural areas must be isolated and oversampled. The methods for locating and oversampling these populations in the primary sample has varied over the years (see section 2.2.2).

2.2 Differentiating Elements

The primary samples for the first ten years of NAEP have differed as to annual allocation by state, locating and oversampling low socioeconomic status (SES) subpopulation, and allocation of second stage or school units. Each of these differences is discussed in the sections which follow.

2.2.1 Control of State Sample Allocation

In Year 01, no control was exercised over sample allocations to states. As a result the primary sample included selected units in 38 of the 50 states. Beginning in Year 02, each state had to be represented in the primary sample annually. This requirement extended through Year 06. In Year 07, a coordinated four-year primary sample was selected extending through Year 10. The four-year sample required that each state be represented at least once over the four-year period.

The all-state requirement was met in Years 02 through 04 by using a controlled selection procedure developed by Jessen. For each region, a table was prepared containing estimated adjusted 17-year-olds (oversampled 17's counted twice) by state and major primary stratum. Major primary strata consisted of the 8 categories obtained by crossing the 4 size of community strata with the low and high (2) SES strata. The total sample allocation of 216 replicates were allocated to regions in proportion to adjusted 17-year-olds in the region. The sample allocation to the region was then apportioned among the state by major stratum cells in proportion to the adjusted 17-year-olds in each cell. States whose allocation by this procedure was .5 or more were designated as two-replicate PSU states. Remaining states were called one-replicate PSU states. In a single replicate state PSU, each package for each age class was administered once with approximately 12 respondents per session. A total of 216 replicates (208

in Year 01) were assigned yielding the planned sample size per package of 2592(12 x 216).

Having computed the expected allocations described above, the next step was the controlled selection of a sample pattern and the selection of the sample primary units given the selection pattern. Controlled selection insured that the actual sample allocation to any cell was within one of the expected allocation. A set of allocations or patterns was developed and probabilities were assigned to these patterns to meet two requirements (1) each pattern must satisfy certain row and column total constraints exactly (i.e., the allocation to each state must be at least 1); and (2) in repeated sampling of the patterns, the overall probability of including any particular cell was fixed. A separate set of patterns was developed for each region and one was selected using the probabilities assigned to the patterns. Having determined the selection pattern, the prescribed number of units was selected from each cell in proportion to the adjusted numbers of 17-year-olds.

The variances associated with estimates derived from controlled selection samples are very complicated. Furthermore, they are biased in the sense that they are overestimates of the variance.

In Year 05, the method of controlled selection was abandoned in favor of a deeply stratified design which met the all-state requirement and at the same time provided simple, relatively unbiased estimates of variance. To insure adequate regional representation, sample PSUs were allocated to NAEP's four regions in proportion to the adjusted size measure described above. The 15 largest SMSAs had adjusted size measures big enough to warrant their inclusion in the sample with certainty. Two additional SMSA PSUs, namely Denver and Phoenix, became self-representing by virtue of the

stratification scheme used to meet the all-state requirement. Non-self-representing PSUs were selected with probabilities strictly proportional to their adjusted 17-year-old population. RTI's approach for meeting the all-state requirement was to delineate primary stage substrata within states which were not already represented by one of the 17 self-representing SMSAs. States were first designated as one-replicate or two-replicate PSU states; a two-replicate PSU state had at least 50,000 total population in each PSU and the PSU was assigned two full sets of NAEP packages for each age class. One-replicate states had a 25,000 population minimum for each PSU and the sample PSU was assigned a single set of NAEP packages. States whose adjusted size measure warranted a proportional allocation of two or more double-replicate PSUs out of a total national allocation of 216 replicates had their non-SMSA counties aggregated to meet the 50,000 size minimum. The non-self-representing SMSA PSUs (SOC2 and SOC3) were then ranked from largest to smallest in terms of adjusted size. The non-SMSA PSUs (SOC4 and SOC5) were ranked from least rural to most rural based on the percentage of rural 14-year-olds. Starting with the largest SMSA units, adjusted size measures were accumulated down the ranking until enough size was aggregated to warrant a proportional allocation of a pair of two-replicate PSUs. Two PSUs were then selected from this state substratum. Any remaining units not included in the largest and least rural aggregate were placed in a regional pool with similar units from other states.

States whose aggregate adjusted size did not warrant a pair of two-replicate units were classified as one-replicate states. Their non-SMSA units were combined to meet a 25,000 minimum population requirement and then ranked from least to most rural behind the SMSA units. Units were

again combined down the list until the aggregated size deserved a proportional allocation of a pair of single-replicate units. Two of these one-replicate PSUs were then selected with probabilities strictly proportional to adjusted size and without replacement.

In order to exercise some control over the sample distributions of PSUs by size of community, those PSUs in the primary frame which belonged to states already covered by self-representing PSUs and those remaining after appropriate sized substrata were carved from the non-self-representing states were placed in a regional pool. Units in the regional pool were first stratified into one- and two-replicate PSU substrata and then ranked by size and percent rural. Additional strata were formed along the size-rural ordering so that each stratum deserved a proportional allocation of two or three units per stratum.

The Year 05 procedure was repeated in Year 06. As noted earlier, a four-year sample was selected in Year 07 for Years 07 through 10. The Year 05 procedure was applied to the four-year sample. It was also decided to reduce the number of primary sampling units or travel points in the four-year sample. This change was motivated by the reduced funding level anticipated for Years 07 through 10. The NAEP sample for Years 02 through 06 contained roughly 115 distinct travel points with each group package scheduled for 216 group sessions of 12 students. To maintain the same sample size for group packages with a drop to roughly 70 travel points per year and 162 group sessions per package, the planned group session size was increased to 16. Since each group session for a particular package is conducted in a separate school, one notes that the design change introduced in Year 07 also implies a reduction in schools assessed per package from 216 to 162. Thus, the four-year sample consisted of 648 replicates (162 x 4).

These replicates were allocated to regions and to states and regional pools within regions exactly as described in the preceding paragraph. However, the allocation and selection consisted of 8 (4 x 2 single- or double-replicate units) PSUs instead of 2. The 8 selected PSUs were then randomly assigned in pairs to each of the four years.

2.2.2 Definition of Low Socioeconomic Status

In Years 01 through 04, low socioeconomic subpopulations were defined in terms of percent of population earning less than $3,000 which at the time was the national poverty level. Approximately 20 percent of the lowest SES-ranked primary units in each region and SOC3 and 4 category were isolated and oversampled at a rate of about 2 to 1 by doubling the selection size measure (i.e., estimated 17-year-olds) in each unit prior to selection. For SOC1 and 2 primary units, low SES schools were oversampled within each unit.

In Years 05 through 10, low SES in urban areas (low metropolitan) was oversampled in a different fashion from rural low SES areas (extreme rural). The use of the percent of population earning less than $3,000 annually to identify low SES subpopulation was abandoned. The two new methods are explained below.

2.2.2.1 Oversampling low metropolitan subpopulations. Low income inner city areas within the largest 65 SMSAs with total populations in excess of 500,000 were isolated. Census Employment Survey (CES) low income inner city Census tracts were used to define low metropolitan areas in the 40 SMSAs where such tracts had been identified. For the 25 cities among the largest 65 SMSAs where CES areas were not defined, compact groups of inner city Census tracts with low income characteristics similar to the CES areas were defined. Oversampling was accomplished by doubling the

estimated numbers of 17-year-olds in these areas prior to primary selection. The low metropolitan areas contained 7.3 percent of the 1970 14-year-olds.

2.2.2.2 Oversampling extreme rural subpopulations. The extreme rural subpopulation was associated with the rural portions of counties whose 1970 14-year-old population was at least 75 percent rural. The estimated numbers of 17-year-olds were doubled prior to primary selection in counties which were 75 percent or more rural. These extreme rural areas account for 10 percent of the 1970 14-year-old population.

2.2.3 Allocation of Second Stage Units

The manner in which second stage units or schools were allocated to selected primary sampling units (PSUs) has varied over the years. The differences can be categorized into two types--definition of second stage units and oversampling low SES in second stage units. Each of these topics is discussed in the following sections.

2.2.3.1 Definition of second stage units. In Years 01 through 04, schools were defined as the second-stage sampling units (SSUs) in smaller primary units. In most of the large PSUs, local area schools were clustered as SSUs to reduce the number of school districts in the sample and to reduce travel costs between sample schools in the same PSU. In forming these clusters, particular emphasis was placed on representing some of both high and low SES populations. In other words, the clusters were as heterogeneous as possible with respect to SES. Additionally, in Year 02 to reduce field costs, a procedure developed by Keyfitz was modified to maximize the probability of selecting the same SSU, for more than one age class.

The Years 05 through 10 secondary samples were designed to allow for simple, unbiased variance estimation. To achieve this purpose, the school frame in large PSUs (i.e., self-representing units) was stratified into two- and three-replicate zones containing populations of similar types. For example, in a particular self-representing unit, one two-replicate zone might consist of low metropolitan and remainder of the city schools; the second zone containing only schools from outside the city limits could account for another two replicates. To simplify estimation of the within PSU variance contribution from self-representing SMSAs, schools were selected in two or three nonoverlapping one-replicate subsamples which would easily accommodate the paired selection variance scheme.

2.2.3.2 Oversampling low SES in second stage units. In Years 01 through 04, schools within each selected primary unit were stratified into two strata, high and low SES, based on an SES index. The SES index was calculated from Internal Revenue Service tax return tabulations by zip code areas. Each school in a particular five-digit zip code area was assigned an SES index equal to the proportion of total tax returns with less than $3,000 adjusted gross income. For SOC1 and 2 primary units, the low SES stratum consisted of schools with one-third of the estimated students and the highest[1] values of the SES index; the remaining two-thirds of the estimated students comprised the high SES stratum. For SOC3 and 4, the low SES stratum was schools with one-half of the estimated students and the highest values of the SES index; the remaining one-half of the estimated students constituted the high SES stratum. SES stratification was effected

[1] Note that a high value of the SES index for a zip code area indicates a high proportion of low SES individuals... a "low SES" area.

separately for each of the three age groups. Approximtely one-half of the sample schools were selected from each of the two SES strata within each primary unit.

In Years 05 through 10, low SES school strata were defined in terms of 1970 Census data. Specifically, low metropolitan schools were those schools located in the Census Employment Survey (CES) low income areas. Extreme rural schools were defined as schools located in non-SMSA counties where the 14-year-old populations in 1970 were at least 75 percent rural. The sample allocation to schools was made after estimated eligibles in low metropolitan and extreme rural schools had been doubled. This procedure had the effect of oversampling low SES schools at a rate of approximately two-to-one in relatien to nonoversampled schools.

The procedure used in Years 05 through 10 was felt to be superior to that employed in earlier years because the oversampled population varied from one primary unit to the next, and the later procedure took advantage of this fact. The earlier procedure maintained a fixed oversampling rate per primary unit regardless of the size of the oversampled population in the PSU.

2.3 Summary Characteristics

Table 2-3 summarizes characteristics from the first ten NAEP samples by year and age class. In Year 01, the sample consisted of 208 replicates. The number of replicates was increased to 216 and controlled selection was used as the method of primary sample selection in Years 02 through 04. A major sample redesign occurred and controlled selection was abandoned as the method of primary selection in Years 05 and 06. A coordinated four-year primary sample was selected in Years 07 through 10, and the number of

Table 2-3. Summary characteristics from first ten NAEP samples

Age & Year	Reps	Schools[a]	Schools per rep	Group package[b]			Individual packages[b]		
					Students[c]			Students[c]	
				No.	Total	Per pkg	No.	Total	Per pkg
Age 9									
01	208	935	4.50	8	19,478	2,435	2	3,715	1,858
02	216	1,007	4.66	9	22,366	2,485	3	6,433	2,144
03	216	782	3.62	4	10,824	2,706	3	6,953	2,318
04	216	971	4.50	7	18,639	2,663	3	6,769	2,256
05	216	1,246	5.77	10	26,053	2,605	1	2,233	2,233
06	216	1,003	4.64	12	28,932	2,411	NA	NA	NA
07	162	412	2.54	4	9,860	2,465	1	2,306	2,306
08	162	451	2.78	7	17,360	2,480	NA	NA	NA
09	162	465	2.87	7	17,190	2,456	NA	NA	NA
10	162	539	3.33	11	27,620	2,511	NA	NA	NA
Age 13									
01	208	749	3.60	9	21,725	2,414	3	5,582	1,861
02	216	1,029	4.76	13	32,328	2,487	2	4,307	2,154
03	216	913	4.23	7	18,669	2,667	3	6,870	2,290
04	216	979	4.53	9	23,503	2,611	3	6,744	2,248
05	216	1,278	5.92	14	36,080	2,577	1	2,239	2,239
06	216	972	4.50	13	30,963	2,382	NA	NA	NA
07	162	549	3.39	12	29,901	2,492	NA	NA	NA
08	162	472	2.91	10	25,663	2,566	NA	NA	NA
09	162	442	2.73	11	26,665	2,424	NA	NA	NA
10	162	496	3.06	13½	37,412	2,771	NA	NA	NA
Age 17									
01	208	670	3.22	11	23,348	2,123	2	3,443	1,722
02	216	631	2.92	10	23,348	2,335	2	4,274	2,137
03	216	759	3.51	9	21,233	2,359	3	6,565	2,188
04	216	798	3.69	11	25,908	2,355	3	6,507	2,169
05	216	1,052	4.87	16	36,709	2,294	1	2,163	2,163
06	216	830	3.84	19	41,286	2,173	NA	NA	NA
07	162	439	2.71	13	29,049	2,235	NA	NA	NA
08	162	428	2.64	14	37,174	2,655	NA	NA	NA
09	162	453	2.80	14	31,576	2,255	NA	NA	NA
10	162	435	2.69	14½	37,083	2,557	NA	NA	NA

[a] Counts only schools where assessment was conducted.

[b] Includes regular sessions and standby sessions.

[c] Excludes followup session counts and includes alternates.

replicates was reduced from 216 to 162. Important primary sample characteristics from each of these time periods are discussed in the sections which follow. Frequent reference is made to table 2-3.

2.3.1 Year 01

Sample allocation to states was not controlled in Year 01, and as a result, 38 out of the 50 states were included in the sample. The sample was also characterized by having 208 replicates and 4.50 9-year-old schools assessed per replicate, while 3.60 and 3.22 13- and 17-year-old schools were assessed per replicate, (see table 2-3). The average group package sample size was 2435, 2414 and 2123 for 9-, 13-, and 17-year-olds compared to a targeted value of 2496 (12 x 208). The average individual package sample size was 1858, 1861, and 1722 for 9's, 13's, and 17's compared to a targetted value of 2080 (10 x 208).

2.3.2 Years 02 through 04

Controlled selection was the method by which the Year 02 through 04 primary samples were selected. Every state and the District of Columbia were represented in the sample every year. The samples were composed of 216 replicates each year. The numbers of schools assessed per replicate per age varied from 3.51 to 4.76. The targeted group package sample size was 2,592 (12 · 216) and the actual average sample size ranged from 2,335 to 2,706. For individual packages, the targeted value was 2,160 (10 · 216) and the actual values ranged from 2,136 to 2,318.

2.3.3 Years 05 and 06

Controlled selection was abandoned as the method of primary sample selection in favor of a deeply stratified sample which fulfilled the all-state requirement and at the same time provided simple, relatively unbiased estimates of variance. Samples in each year were composed of 216 replicates.

A maximum number of schools was assessed per replicate in Year 05-5.77 for 9-year-olds, 5.92 for 13-year-olds, and 4.87 for 17-year-olds. The average group package sample size ranged from 2,173 to 2,605. Individual packages were administered in Year 05 only and in every case the targeted sample size was met.

2.3.4 Years 07 Through 10

The deeply stratified sample which fulfilled the all-state requirement and provided simple, relatively unbiased estimates of variance was extended to a four-year period. The number of students per group administration was increased from 12 to 16 so that the number of replicates could be decreased from 216 to 162. Decreasing the number of replicates accounted for a sizeable reduction in field costs. Increasing the group size per administration allowed the targeted sample sizes of 2,592 to be met (i.e., $216 \cdot 12 = 162 \cdot 16 = 2{,}592$). The total numbers of schools selected per year was maintained at 1,600. In previous years, about twice this number of schools was selected. Schools were kept to a minimum to reduce field costs. The numbers of schools assessed per replicate ranged from 2.54 to 3.33 which was considerably below the level of earlier years. Average group package sample sizes varied from 2,235 to 2,771. One individual package was administered in Year 07 at age 9 and the targeted sample size was met.

3. SAMPLING FRAME CONSTRUCTION

3.1 Sampling Frame Units

The units used for constructing the basic sampling frame file were the counties and county-equivalent independent cities recognized by the Census Bureau in 1970. Washington, D.C. was included as a single frame unit, though it is neither an independent city nor county as in other states. Except for the Alaska portion of the frame, there was one sampling frame unit for each 1970 county and county equivalent.

For the Alaska portion of the frame, the two largest Census Divisions (county equivalent), Anchorage Census Division and Fairbanks Census Division, each comprised a frame unit, since each had a sizeable city and was reasonably compact and accessible. These two units, alone, contained 56 percent of the state's population in 1970. The third frame unit for Alaska was comprised of the Juneau Census Division and 21 specific places. All the included places had 1970 populations of 1,000 or more, or are in close proximity to such a place, and are accessible via regular air transportation. In total, the three Alaska frame units contain 75.7 percent of the state's 1970 population.

The sampling frame was comprised of a total of 3,115 basic units.

3.2 Sampling Frame Variables and Data Sources

A data record was compiled for each sampling frame unit consisting of 33 primary variables representing identification and descriptive data. Additional size measure and stratification variables were computed or derived from the primary data and added to the data records. Following is a description of each frame variable, including the source of the data and estimation procedure, if applicable. Variables are listed alphabetically by SAS name.

AGE 9 - Estimated 9-year-olds, 1977-78

The number of 9-year-olds enrolled in the county in 1977-78 was estimated as follows:

AGE 9 = .0082 (2nd grade enrollment) + .2386 (3rd grade enrollment)
+ .7387 (4th grade enrollment) + .0051 (5th grade enrollment).

Grade enrollments were obtained by summarizing to the county level Curriculum Information Center's 1977-78 school-level grade-by-grade data for public, Catholic and other private schools. The proportions of 9-year-olds among the grade's enrollments, the coefficients in the computation formula, were estimated using weighted National Assessment data and October 1975 year-by-grade population estimates from Current Population Reports.

AGE 13 - Estimated 13-year-olds, 1977-78

The number of 13-year-olds enrolled in the county in 1977-78 was estimated as follows:

AGE 13 = .0231 (6th grade enrollment) + .2314 (7th grade enrollment)
+ .6954 (8th grade enrollment) + .0036 (9th grade enrollment).

Grade enrollments and coefficients were determined as described for AGE 9.

AGE 17 - Estimated 17-year-olds, 1977-78

The number of 17-year-olds enrolled in the county in 1977-78 was estimated as follows:

AGE 17 = .0148 (9th grade enrollment) + .1345 (10th grade enrollment)
+ .7896 (11th grade enrollment) + .1203 (12th grade enrollment).

Grade enrollments and coefficients were determined as described for AGE 9.

ASIANPOP - Asian Population, 1970

The source of the 1970 Asian population count was the "other specified races" item of Tabulation 20 of the 1970 Census First Count tapes, File B (county level summary records). As described in Census User's Guide, Part II, "other specified races" includes, specifically, Japanese, Chinese, Filipino, Hawaiian and Korean. For Alaska, Hawaiian and Korean are replaced

by Aleut and Eskimo. (In other states, Aleut and Eskimo are not included in the Asian count).

ASIZE - Estimated Asian Size Measure

The estimated Asian population size measure was computed as follows:

$$\text{ASIZE} = \frac{\text{Asian population, 1970}}{\text{Total population, 1970}} \cdot \left(\begin{array}{l}\text{Average number of estimated enrolled} \\ \text{9's, 13's and 17's, 1977-78}\end{array}\right)$$

$$= \frac{\text{ASIANPOP}}{\text{TOTPOP}} \cdot \text{SIZE}$$

A description of terms of the expression may be found in this list by referring to the SAS variable names given.

ASTATE - Postal Abbreviation for the State

The Postal abbreviation is a two-letter state identification code. For the sampling frame file, these codes were taken from the CIC school data file previously described.

BIASCHLS - Bureau of Indian Affairs Schools in County

A data tape containing names and addresses of approximately 200 Bureau of Indian Affairs schools was received from CIC in the Summer of 1978. The address ZIP code was used to determine each school's county, and the number of included BIA schools was tabulated for each county.

BLACKPOP - Black Population, 1970

The source of the 1970 Black population count was the 'Negro' race item of Tabulation 20 of the 1970 Census First Count tapes, File B (county level summary records). Census User's Guide, Part II states: "Negro..Includes persons who indicated their race as 'Negro or Black.' Also includes persons who indicated the 'other race' category and furnished a written entry that should be classified as 'Negro or Black.'"

BSIZE - Estimated Black Size Measure

The estimated Black population size measure was computed as follows:

$$\text{BSIZE} = \frac{\text{Black population, 1970}}{\text{Total population, 1970}} \cdot \left(\begin{array}{l}\text{Average number of estimated enrolled} \\ \text{9's, 13's, 17's, 1977-78}\end{array}\right)$$

$$= \frac{\text{BLACKPOP}}{\text{TOTPOP}} \cdot \text{SIZE}$$

A description of the terms of the expression may be found in this list by referring to the SAS variable names given.

CENDIV - Census Geographic Division

The Census geographic division containing the state is designated by a one-digit code, as follows:

1 - New England
2 - Middle Atlantic
3 - South Atlantic
4 - East South Central
5 - West South Central
6 - East North Central
7 - West North Central
8 - Mountain
9 - Pacific

CESAREA - Census Employment Survey Area Population

As part of the Census, data is published for low income areas (called Census Employment Survey [CES] areas) within selected large cities. In 1970, the Census Bureau defined clusters of census tracts in 40 of the 65 largest Standard Metropolitan Statistical Areas (SMSA) as CES areas. These are areas with high percentages of Blacks, high percentages of poverty families, high unemployment rates, and low percentages of professional workers. RTI has similarly identified compact groups of inner city Census tracts in 25 additional SMSA's so that CES-type areas are defined in all of the 65 largest SMSAs. A data file has been constructed by RTI of identification and descriptive information for each tract in the CES area of the

65 largest SMSAs. The data for this file was extracted from 1970 First Count Files, as described in the 1970 Census User's Guide, Part II. The total population of CES area Census tracts were summed to the county level and these counts were added to the NAEP sampling frame records.

COMSIZE - Community Size Stratum

The Community Size Stratum is designed by a one-digit code, defined as follows:

1 - SMSA counties containing all or part of a central city ("big city") with 200,000 or more population in 1970.

2 - Remaining counties in "big city" SMSA's, i.e., SMSA's having central cities with 200,000 or more population in 1970.

3 - SMSA counties containing a central city or other place of 25,000 or more population in 1970, but not in a "big city" SMSA.

4 - SMSA counties not containing a central city or other place of 25,000 or more population, and not in a "big city" SMSA.

5 - Non-SMSA counties containing all or part of a place with 25,000 or more population in 1970.

6 - Non-SMSA counties with total urban population of 10,000 or more in 1970, but not having a place of 25,000 or more population.

7 - Non-SMSA counties with a total urban population of less than 10,000 in 1970 and not containing any portion of a place of 25,000 or more population in 1970.

COUNTY - 1970 Census County Code

Within each state, counties or county equivalents are identified by a unique three-digit code assigned by the Census Bureau as part of the 1970 geographic code scheme. The code scheme may be found in various Census publications, e.g., FIPS.PUB 6-1. The source of the numeric codes for the sampling frame file was the CIC school data file. The Alaska frame unit representing, collectively, 21 specific places and the Juneau Census Division was arbitrarily assigned a county code of 999.

CSIZE - Estimated Size Measure Within CES Area

The estimated size measure (average of 9-, 13- and 17-year-old enrollment, 1977-78) within the Census Employment Survey areas was computed as follows:

$$\text{CSIZE} = \frac{\text{CES area population, 1970}}{\text{Total population, 1970}} \cdot \left(\begin{array}{l}\text{Average number of estimated en-}\\ \text{rolled 9's, 13's, \& 17's, 1977-78}\end{array}\right)$$

$$= \frac{\text{CESAREA}}{\text{TOTPOP}} \cdot \text{SIZE}$$

A description of the terms of the expression may be found in this list by referring to the SAS variable names given.

HISPOP - Maximum of Hispanic Indicators

Three Hispanic indicators were formed for each county or county equivalent from data of Table 24, Census 4th count file, as follows:

H1 = Number of persons classified in any of the five Spanish categories of the question on "origin or descent" (5 percent sample).

H2 = Number of persons of Puerto Rican birth or parentage (15 percent sample).

H3 = Number of persons of "Spanish language" and, in the five Southwestern States (Arizona, California, Colorado, New Mexico and Texas) persons not of Spanish language but of Spanish surname (15 percent sample).

The definitions of each of these categories may be found in a number of Census publications, including General Social and Economic Characteristics, United States Summary, Appendix B.

The maximum of the three values, H1, H2 and H3, for each county and county equivalent was added to the NAEP sampling frame file as the variable HISPOP.

HSIZE - Estimated Hispanic Size Measure

The estimated Hispanic population size measure was computed as follows:

$$\text{HSIZE} = \frac{\text{Hispanic population (maximum), 1970}}{\text{Total population, 1970}} \cdot \left(\begin{array}{l}\text{Average number of esti-}\\ \text{mated enrolled 9's, 13's,}\\ \text{\& 17's 1977-78.}\end{array}\right)$$

$$= \frac{\text{HISPOP}}{\text{TOTPOP}} \cdot \text{SIZE}$$

A description of the terms of the expression may be found in this list by referring to the SAS variable names given.

INDIAN - American Indian Population, 1970

The American Indian population for the county or county equivalent was taken from a file constructed using data of 1970 Census First Count Tapes, File B, Table 20. For a description of this data source, see the 1970 Census User's Guide, Part II.

ISIZE - Estimated Indian Size Measure

The estimated American Indian population size measure was computed as follows:

$$\text{ISIZE} = \frac{\text{American Indian population, 1970}}{\text{Total population, 1970}} \cdot \left(\begin{array}{l}\text{Average number of estimated}\\ \text{enrolled 9's, 13's, \& 17's,}\\ \text{1977-78.}\end{array}\right)$$

$$= \frac{\text{INDIAN}}{\text{TOTPOP}} \cdot \text{SIZE}$$

A description of the terms of the expression may be found in this list by referring to the SAS variable names given.

LATITUDE - County 1970 Population Center Latitude

The latitude of the computed location of the county's 1970 center of population was taken from a Census Bureau data tape available through Triangle Universities Computing Center (TUCC). The computed population center latitude is expressed in decimal degrees.

LONGITUDE - County 1970 Population Center Longitude

See LATITUDE for a description of the source of this data.

LU - Listing Unit Number

Thirty-eight independent cities in Virginia had county-equivalent status at the time of the 1970 Census. When the frame unit file was first established, it was recognized that due to their small sizes, many of these independent cities would ultimately need to be combined with some other unit(s) to form final sampling units. To facilitate this expected combinational process, every independent city was grouped with a county unit, and all frame units of a grouping were assigned the same four-digit listing unit number.

NAEPREG - Office of Business Economics Region

National Assessment reporting regions coincide with the Office of Business Economics Regions, and these are designed by a one-digit code, as follows:

1 - Northeast
2 - Southeast
3 - Central
4 - West

NAME - County Name

The county or county equivalent name was taken from the CIC school file. The Alaska frame unit representing, collectively, 21 specific places and the Juneau Census Division was labeled "Alaska balance."

NSTATE - 1970 Census State Code

The two-digit 1970 Census state code (numeric) was taken from a specially prepared SAS data set linking the state alphabetic code, state numeric code and other geographic identifiers.

OVERSIZE - Oversampling Size Measures

National Assessment directed that low-income, inner-city areas (CES areas) and extreme rural areas be oversampled to ensure adequate sample

sizes for Blacks and rural students to permit reporting of results for these subpopulations. To facilitate the oversampling of these areas at twice the rate of all other areas, an oversampling size measure was computed for each frame unit, as follows:

OVERSIZE = Frame unit size measure + CES area size measure + extreme rural size

= SIZE + SCIZE + RURSIZE .

The effect of the indicated computation is to double the size measure for the CES areas and extreme rural areas. (Note: By the manner of their definition, CES areas and extreme rural areas never occur in the same frame unit.)

POP200K - County Population in Cities Over 200,000

The county population in cities over 200,000 population in 1970 was summarized from the 1972 County and City Data Book tape file.

POP25K - County Population in Cities Over 25,000

The county population in cities over 25,000 population in 1970 was summarized from the 1972 County and City Data Book tape file.

PQOCCA - Professional, Technical and Managerial Workers

The county 1970 employment in major occupational categories: (1) professional, technical and kindred workers, and (2) managers and administrators, except farm, was summarized from Census 4th Count files Table 68. This corresponds to NAEP Principal's Questionnaire occupational category A.

PQOCCB - Sales, Clerical, Foremen and Skilled Workers

The county 1970 employment in major occupational categories: (1) sales workers, (2) clerical and kindred workers, (3) craftsmen, foremen, and kindred workers, was summarized from Census 4th count files, Table 68. This corresponds to NAEP Principal's Questionnaire occupation category B.

PQOCCC - Blue Collar, Service and Private Household Workers

The county 1970 employment in major occupational categories: (1) operatives, except transport, (2) transport equipment operatives, (3) laborers, except farm, (4) service workers, except private household, and (5) private household workers, was summarized from Census 4th count files, Table 68. This corresponds to NAEP's Principal's Questionnaire occupation category C.

PQOCCD - Farm Workers

The county 1970 employment in major occupational categories: (1) farmers and farm managers, and (2) farm laborers and foremen was summarized from Census 4th count files, Table 68. This corresponds to NAEP Principal's Questionnaire occupation category D.

PQOCCE - Unemployed Persons in Labor Force, 1970

The county's number of unemployed members of the labor force in 1970 was computed using data from the 1972 County and City Data Book tape file, as follows:

PQOCCE = Civilian labor force, 16 years old and over x percent unemployed of the civilian labor force x .01.

This corresponds to NAEP Principal's Questionnaire occupation category E.

PQOCCF - Recipients of OAA and AFDC, Feb. 1972

The number of recipients of old age assistance and aid to families with dependent children in February 1972 was summarized from data in the 1972 County and City Data Book tape file. For some counties and county equivalents, data were not available separately, but were presented in combination with other units. Missing data were estimated by prorating the combined OAA/AFDC counts to counties in proportion to their total populations.

RURALPOP - Rural Population, 1970

The county rural population in 1970 was summarized from the Census 4th count files.

RURSIZE - Extreme Rural Size Measure

The extreme rural population size measure was defined as follows:

$$\text{RURSIZE} = \begin{cases} \text{SIZE if SDOC} = 5, \text{ i.e., if frame unit description of community is extreme rural;} \\ 0 \quad \text{otherwise .} \end{cases}$$

SCHL9 - Schools With Grades 2, 3, 4, or 5

The number of schools having any of the grades containing 9-year-olds (grades 2, 3, 4 or 5) was obtained by summarizing Curriculum Information Centers 1977-78 file of public, Catholic and other private schools.

SCHL13 - Schools With Grades 6, 7, 8, or 9

The number of schools having any of the grades containing 13-year-olds (grades 6, 7, 8 or 9) was obtained by summarizing Curriculum Information Center's 1977-78 file of public, Catholic and other private schools.

SCHL17 - Schools With Grades 9, 10, 11 or 12

The number of schools having any of the grades containing 17-year-olds (grades 9, 10, 11 or 12) was obtained by summarizing Curriculum Information Center's 1977-78 file of public, Catholic and other private schools.

SDOC - Sampling Description of Community

The sampling description of community classification represents a recoding of the community size strata (COMSIZE) as shown on the following page.

As shown by the table, the counties with COMSIZE codes of 7, i.e., non-SMSA counties with urban populations less than 10,000 and with no portion of a city of 25,000 or more, were partitioned into two sets--an 'extreme rural' set and a 'non-extreme rural' set prior to assigning SDOC

SDOC Category	Includes COMSIZE Codes
1	1
2	2
3	3,5
4	4, 6, 7 ('non-extreme rural' counties)
5	7 ('extreme rural' counties)

codes. Identification of the 'extreme rural' set was done in several steps. First, counties without farm employment (PQOCCD = 0) were identified and defined to be 'non-extreme rural' counties. For the remaining counties having COMSIZE codes of 7, an 'extreme rural' index was computed as follows:

$$\text{Extreme Rural Index} = \frac{\text{PQOCCD} - \text{PQOCCC} - 2(\text{PQOCCA})}{\text{PQOCCA} + \text{PQOCCB} + \text{PQOCCC} + \text{PQOCCD} + \text{PQOCCE}}$$

A high value of the index indicates a relatively high proportion of farm workers in the county labor force and a relatively low proportion of professional, technical, and managerial workers and of factory and other blue-collar and service workers. The counties were ranked on the index from highest value to lowest value, and the extreme rural counties were identified as those having an index value of -0.607 or greater. In the northeast, an index value of -0.681 was required to allow an allocation of at least 1 replicate per annual sample. Given that extreme rural is to be sampled at a rate twice that of non-extreme areas, this definition assures that 10 percent of the sample will be extreme rural. Thus, non-SMSA counties with a total urban population of less than 10,000 in 1970, not containing any portion of a place of 25,000 or more population in 1970, and possessing a large enough extreme rural index to insure that 10 percent of

the sample would be extreme rural were classified as SDOC5. Remaining non-SMSA counties with urban populations less than 10,000 and with no portion of a city of 25,000 or more were classified as SDOC4. In the northeast since a different extreme rural index cut-off point was required, the categories were called SDOC6 and 7.

SIZE - Average of Estimated 9's, 13's and 17's, 1977-78

The basic size measure for each frame unit was computed as the average of estimated 1977-78 9-, 13-, and 17-year-old enrollments, as follows:

SIZE = (AGE9 + AGE13 + AGE17)/3 .

SMSA - 1970 SMSA Code

The 1970 four-digit SMSA codes were taken from county summary records of the Census First Count files. In New England, counties containing more than one SMSA were assigned the code of the predominant SMSA, and counties with less than 50 percent urban population were not assigned SMSA codes.

SMSA77 - 1977 SMSA or New England County Metropolitan Area (NECMA) Code

The current SMSAs and codes were taken from the publication Standard Metropolitan Statistical Areas, 1975 and subsequent OMB Information Office releases. New England County Metropolitan Area codes were taken from the same source.

TOTPOP - Total Population, 1970

The county total population was derived from intermediate data from Census 4th count files, as follows:

TOTPOP = Urban population + Rural population .

Urban population was not retained as a separate item.

3.3 Editing and Verification Procedures

Numerous editing and verification procedures were performed during compilation of the sampling frame to ensure its accuracy and completeness.

Whenever possible, frame data were verified, either directly or in summary form, by comparison to published data, usually Census reports. Discrepancies were investigated by tracing the frame data through each stage of its development from its origin. Inaccurate data were replaced either by developing correct data for all records from the source and merging to the frame file or by selectively correcting the file using direct interactive editing procedures.

The following specific edits and verifications were performed:

(A) The number of county equivalent frame units for each state was verified to a count made from a listing of counties in a FIPS publication.

(B) School count and age enrollment totals were obtained from the frame file and compared for reasonableness with data from the 1975 Current Population Survey and 1976 Digest of Educational Statistics.

(C) The number of 1970 Standard Metropolitan Statistical Area (SMSA) counties by state was tabulated from the frame file and verified using published Census information.

(D) The 1970 SMSA codes represented on the frame file were listed numerically and verified to a published Census list.

(E) The 1977 SMSA counties were listed, by SMSA, from the frame file and the listing was verified to the source document, Standard Metropolitan Statistical Areas, 1975.

(F) State totals were obtained from the frame file for total population, rural population and Black population, and these were checked against published Census data. Only minor differences were found.

(G) For the state of Virginia, a 100 percent check was made of master file county total population and rural population against published Census data. Only minor differences were noted. A complete check was also made of county population in places of 25,000 or more and places of 200,000 or more. Arbitrarily selected counties were checked for correctness of employment by occupation totals, the unemployment count, and Old Age Assistance and Aid for Dependent Children Recipient count. These county level checks showed that erroneous data wre present in the frame file for some variables. Correct data were obtained and substituted.

(H) A Statistical Analysis System (SAS) procedure, DATACHK, was used to identify and list the five largest and five smallest values of each frame file descriptive variable. These extreme data were verified individually against published data.

4. STRATIFICATION

4.1 Overview

NAEP and RTI staff agreed that the primary sample selection in Year 11 would be a coordinated four-year sample. The discussions which preceded the design of this sample brought to light a number of sampling objectives. These objectives and the sampling approach to implement them are discussed in the sections which follow.

4.1.1 Sample Design Objectives

A major objective of the four-year primary sample beginning in Year 11 was to insure that at least one PSU was present in each region by size of community category annually. In previous primary samples, this control had not been maintained, and as a result, the numbers of sample respondents in size and type of community (STOC) cells were not stable from year-to-year. Extreme fluctuations were noted when region was crossed with STOC.

Another major objective was to insure that each state and the District of Columbia was represented at least once in the four-year primary sample. It was also desired to have the sample be as widely dispersed as possible over the four-year period. Basically, controlled selection was liked for its sample control but not liked for its complicated, biased estimates of variance.

A third design objective was to reduce the geographic size of PSUs. This modification would have the effect of (1) reducing field costs as well as aiding the field staff and (2) reducing the number of reselected districts. Since PSUs are selected in proportion to population, larger geographic areas are selected more frequently since, in general, they contain a larger population. Although control is maintained so that no school is

selected more than once in a four-year period, no such control is exercised over districts.

Redefining sampling size of community to more closely align with size and type of community definitions was a fourth design objective.

Objective five concerned the target population which consisted of 9-year-olds, 13-year-olds, and 17-year-olds enrolled in school as well as 17-year-olds who were dropouts and early graduates. In Year 11, 9-year-olds and 13-year-olds were defined as individuals born during calendar years 1970 and 1966, respectively; 17-year-olds were defined as persons born between October 1, 1962 and September 30, 1963.

In order to insure adequate sample representation for the reporting subpopulations, low income and extreme rural areas will be oversampled as the sixth objective.

Objective seven states that a school will appear in the sample no more than once every four years. A school may appear in the sample for more than one age. However, when this situation occurs, it must happen in the same assessment year. Also schools appearing in the Year 10 sample will be excluded from the Year 11 sample.

An eighth design objective, concerned estimates of sample variance which were simple and relatively unbiased.

The last objective stated that each annual sample be able to accommodate either 75 PSUs with 550 schools at each age level or 100 PSUs with 1000 schools at each age level.

4.1.2 Implementing These Objectives

In order to implement the design objectives stated in section 4.1.1, a highly stratified four-year primary sample was developed. In response to objective one, a single sample of 162 replicates was allocated to region

and size of community categories in proportion to adjusted average numbers of 9-, 13-, and 17-year-olds in each class. The single sample allocation was multiplied by the total number of samples to determine the total allocation (see table 5-1). The single and total sample allocations were then translated into numbers of one-, two-, and three-replicate units (see table 5-2). This procedure ensured that each region by size of community category was represented in each sample. The specific procedure is discussed further in section 4.2.

To represent each state and the District of Columbia in each sample and to disperse the sample as widely as possible, for each region by community category, the sampling frame was ordered in a serpentine fashion and equal sized zones were formed to accommodate the region by size of community allocation. One sampling unit was selected from each zone thus insuring a wide dispersion of the sample as well as representing each state over the total sample.

In response to objective three, Standard Metropolitan Statistical Areas (SMSAs) were abandoned as primary sampling units. Instead single counties were used to define PSUs. Counties estimated to contain fewer than 1,500 average 9-, 13-, and 17-year-olds were grouped with near neighbor counties in the same state and community category until a minimum size of 1,500 was achieved.

Sampling description of community (SDOC) was developed to more closely align sampling size of community with STOC as stated in objective four. SDOC is discussed and defined in section 5.2.

The target populations defined in objective five were observed.

In response to objective six, the Census Employment Survey (CES) low income areas were used to define and oversample low metropolitan areas in

40 Standard Metropolitan Statistical Areas (SMSAs) where such tracts had been identified. For the 25 cities among the largest 65 SMSAs where CES areas were not defined, compact groups of inner city Census tracts with low income characteristics similar to the CES areas were defined. The extreme rural subpopulation was defined, and oversampled, as those counties classified as SDOC5.

Objective seven was met and no school will appear in the sample more than once every four years.

The eighth objective concerning simple, relatively unbiased estimates of variance was met by selecting independent school samples for each replicate within each PSU. Single-replicate PSUs were paired with another single unit or double unit in the same region and size of community category. With two, or three, primary units per stratum, simple squared differences provide direct estimates of the variance among PSUs within strata. The variance of NAEP proportion correct (P-value) ratio estimators and other related nonlinear statistics, such as "Raw" and "Balanced" change in proportion correct (ΔP-values), can be approximated by forming squared differences between appropriate Jackknife pseudovalues.

Accommodating the last objective of 75 PSUs with 550 schools per age class or 100 PSUs with 1000 schools per age class is discussed in section 6. Briefly, the objective was met by defining a fifth primary sample which could be used for the dual purposes of (1) augmenting the 75 PSU primary sample up to the 100 PSU level or (2) providing replacement PSUs for those which refuse.

4.2 Sample Allocation by Region and SDOC Category

As noted in section 4.1, a major objective of the Year 11 primary sample was the selection of at least one PSU annually from each region by

size of community category in order to reduce annual fluctuations in numbers of sample respondents by STOC categories. This objective was met by allocating a single sample of 162 replicates in proportion to a measure of size for each region by SDOC category. SDOC categories are defined in section 3.2. The measure of size was the average number of 9-, 13-, and 17-year-olds counting those in inner city and extreme rural areas twice. Inner city (CESAREA) and extreme rural (RURSIZE) areas are defined in section 3.2. The size measure for each region by SDOC category as well as the proportional allocation of 162 replicates in fractional and integer form is shown in table 5-1. As noted in section 3.2, it was necessary to increase the extreme rural index cut-off for the Northeast from -0.607 to -0.681 to allow an allocation of at least one replicate for the single sample. By this procedure SDOC6 and 7 (comparable to SDOC4 and 5) were defined in the Northeast. The integer single-sample allocation was multiplied by 5 in table 4-1 to obtain the total sample allocation.

In table 4-2, the single and total simple allocations of 162 and 810 replicates, respectively, were partitioned into 1-, 2-, and 3-replicate units. In region 1 and SDOC1 category, 13 replicates were to be selected for a single sample which translates into 5 2-replicate units and 1 3-replicate unit ($5 \cdot 2 + 1 \cdot 3 = 13$). The total five-sample allocation, for this region and SDOC category, was 65 replicates ($13 \cdot 5$) which translates into 25 2-replicate units and 5 3-replicate units ($5 \cdot 5 \cdot 2 + 5 \cdot 1 \cdot 3 = 65$).

4.3 Meeting the All-State Requirement Over a Four-Year Period

In order to ensure that each state and the District of Columbia were included in the sample over a four year period and that the sample was widely dispersed, the frame was ordered in a serpentine geographic fashion

Table 4-1. Sample allocation by region and SDOC categories

Region	SDOC	Size measure	Single-sample allocation	Integer single sample allocation	Five-sample allocation
1	1	337,519	12.67	13	65
	2	231,294	8.68	9	45
	3	321,465	12.07	12	60
	6	127,115	4.77	5	25
	7	20,769	0.78	1	5
		1,038,162	38.97	40	200
2	1	171,171	6.42	6	30
	2	90,011	3.38	3	15
	3	272,331	10.22	10	50
	4	312,766	11.74	12	60
	5	127,759	4.80	5	25
		974,038	36.56	36	180
3	1	382,934	14.37	14	70
	2	186,151	6.99	7	35
	3	268,679	10.08	10	50
	4	188,897	7.09	7	35
	5	211,410	7.94	8	40
		1,238,071	46.47	46	230
4	1	496,084	18.62	19	95
	2	78,696	2.95	3	15
	3	268,835	10.09	10	50
	4	138,779	5.21	5	25
	5	83,343	3.13	3	15
		1,065,737	40.00	40	200
TOTAL		4,315,008	162.00	162	810

Table 4-2. Allocation in terms of 1-, 2-, and 3-replicate units

		Single-sample allocation				Five-sample allocation			
Region	SDOC	Total reps	1-rep	2-rep	3-rep	Total reps	1-rep	2-rep	3-rep
1	1	13	-	5	1	65	-	25	5
	2	9	-	3	1	45	-	15	5
	3	12	-	6	-	60	-	30	-
	6	5	1	2	-	25	5	10	-
	7	1	1	-	-	5	5	-	-
		40	2	16	2	200	10	80	10
2	1	6	-	3	-	30	-	15	-
	2	3	1	1	-	15	5	5	-
	3	10	-	5	-	50	-	25	-
	4	12	-	6	-	60	-	30	-
	5	5	1	2	-	25	5	10	-
		36	2	17	-	180	10	85	-
3	1	14	-	7	-	70	-	35	-
	2	7	-	2	1	35	-	10	5
	3	10	-	5	-	50	-	25	-
	4	7	1	3	-	35	5	15	-
	5	8	-	4	-	40	-	20	-
		46	1	21	1	230	5	105	5
4	1	19	-	8	1	95	-	40	5
	2	3	1	1	-	15	5	5	-
	3	10	-	5	-	50	-	25	-
	4	5	1	2	-	25	5	10	-
	5	3	1	1	-	15	5	5	-
		40	3	17	1	200	15	85	5
TOTAL		162	8	71	4	810	40	355	20

and equal sized zones were formed to accommodate the total sample allocation for each region by SDOC category. One sampling unit was selected from each zone. Since the total sample allocation was 810 replicates or 415 units (40 3-rep + 355 2-rep + 20 1-rep) and the frame was ordered in a systematic fashion and one unit only was selected from each zone, the sample was assured of having a wide dispersion as well as meeting the all-state requirement. The total sample allocation by region, state, and SDOC is provided in table 4-3 while the serpentine ordering of states is provided in table 4-4. An example of how the serpentine ordering is applied to the sampling frame is provided in section 4.4.2 for one region by SDOC category.

4.4 Selecting the Sample

Before the primary sample could be selected, all counties in the United States had to be formed into primary listing units. The listing units were then ordered, zones were formed, and the total sample was selected. The total sample was assigned to years. Each of these topics is discussed in the sections which follow.

4.4.1 Form Listing Units

In order for each PSU to contain enough population to accommodate the selection of 1,000 schools per age class, it was determined that each PSU must contain a minimum of 1,500 average 9-, 13-, and 17-year-olds. A PSU was then defined as any county or group of near neighbor counties in the same state and of the same SDOC type with a total average number of estimated 9-, 13-, and 17-year-olds of at least 1,500.

Any county which had an estimated average number of 9-, 13-, and 17-year-olds of at least 1,500 was automatically classified as a PSU. A listing by state and SDOC of all counties whose estimated average number of

Table 4-3. Five-sample allocation by region, state, and SDOC

State	SDOC1	SDOC2	SDOC3	SDOC6	SDOC7	Total
			Northeast region			
Connecticut	-	-	9.70	0.70	-	10.40
District of Columbia	3.28	-	-	-	-	3.28
Delaware	-	-	1.49	0.70	-	2.19
Massachusetts	2.78	10.87	5.87	0.68	-	20.20
Maryland	3.92	9.69	0.67	1.39	1.21	16.88
Maine	-	-	1.50	2.47	-	3.97
New Hampshire	-	0.57	1.32	1.15	-	3.04
New Jersey	5.63	10.64	7.31	2.45	-	26.03
New York	35.64	3.15	18.94	5.83	1.40	64.96
Pennsylvania	13.75	10.08	10.23	8.28	1.21	43.55
Rhode Island	-	-	2.57	0.46	-	3.03
Vermont	-	-	0.40	0.89	1.18	2.47
	65.00	45.00	60.00	25.00	5.00	200.00
			Southeast region			
Alabama	2.28	0.48	4.87	4.92	1.10	13.65
Arkansas	-	0.17	2.40	3.34	2.70	8.61
Florida	10.39	1.05	10.20	3.75	1.51	26.90
Georgia	3.83	2.55	3.51	6.30	3.03	19.22
Kentucky	2.60	0.99	1.57	4.16	4.85	14.17
Louisiana	2.83	1.74	4.81	5.06	1.60	16.04
Mississippi	-	0.19	2.86	4.98	1.89	9.92
North Carolina	1.47	0.68	7.14	7.54	3.44	20.27
South Carolina	-	-	4.21	5.73	0.93	10.87
Tennessee	4.80	1.12	3.43	4.82	1.57	15.74
Virginia	1.80	6.03	2.80	5.45	2.08	18.16
West Virginia	-	-	2.20	3.95	0.30	6.45
	30.00	15.00	50.00	60.00	25.00	180.00

(continued)

Table 4-3. Five-sample allocation by region, state, and SDOC (cont.)

State	SDOC1	SDOC2	SDOC3	SDOC6	SDOC7	Total
			Central region			
Iowa	0.93	0.43	3.63	0.94	7.85	13.78
Illinois	19.95	8.59	5.85	4.43	3.92	42.74
Indiana	3.10	2.03	7.86	4.65	2.25	19.89
Kansas	1.31	1.63	1.31	1.74	3.03	9.02
Michigan	9.53	7.92	9.83	6.52	0.99	34.79
Minnesota	5.24	2.65	2.37	2.36	5.33	17.95
Missouri	5.87	4.74	1.93	2.69	4.79	20.02
North Dakota	-	-	0.81	0.34	1.96	3.11
Nebraska	1.63	0.27	0.70	1.03	3.43	7.06
Ohio	18.69	4.91	8.48	6.74	0.55	39.37
South Dakota	-	-	0.74	0.56	2.19	3.49
Wisconsin	3.75	1.83	6.49	3.00	3.71	18.78
	70.00	35.00	50.00	35.00	40.00	230.00
			West region			
Alaska	-	-	0.65	0.46	-	1.11
Arizona	6.47	-	0.49	1.63	-	8.59
California	44.95	5.16	21.84	3.73	0.41	76.09
Colorado	1.61	3.89	2.07	1.19	1.01	9.77
Hawaii	3.05	-	0.02	0.04	-	3.11
Idaho	-	-	1.03	1.10	1.55	3.68
Montana	-	-	0.89	0.96	1.51	3.36
New Mexico	1.34	0.07	1.08	1.69	0.22	4.40
Nevada	-	-	1.69	0.35	0.08	2.12
Oklahoma	4.25	0.70	1.15	2.33	1.99	10.42
Oregon	2.44	0.69	1.92	2.13	0.66	7.84
Texas	26.82	2.89	8.98	5.59	6.25	50.53
Utah	-	-	3.49	0.94	0.25	4.68
Washington	4.07	1.60	4.28	2.23	0.52	12.70
Wyoming	-	-	0.42	0.63	0.55	1.60
	95.00	15.00	50.00	25.00	15.00	200.00
TOTAL	260.00	110.00	210.00	145.00	85.00	810.00

Table 4-4. Serpentine ordering of states within region

Northeast	Southeast	Central	West
1 Maine	1 Mississippi	1 Iowa	1 Alaska
2 New Hampshire	2 Louisiana	2 Wisconsin	2 Montana
3 Massachusetts	3 Arkansas	3 Michigan	3 Wyoming
4 Rhode Island	4 Tennessee	4 Ohio	4 Idaho
5 Connecticut	5 Kentucky	5 Indiana	5 Nevada
6 New Jersey	6 West Virginia	6 Illinois	6 Utah
7 Delaware	7 Virginia	7 Missouri	7 Colorado
8 District of Columbia	8 North Carolina	8 Kansas	8 Oklahoma
9 Maryland	9 South Carolina	9 Nebraska	9 Texas
10 Pennsylvania	10 Georgia	10 South Dakota	10 New Mexico
11 New York	11 Florida	11 North Dakota	11 Arizona
12 Vermont	12 Alabama	12 Minnesota	12 Hawaii
			13 California
			14 Oregon
			15 Washington

9-, 13-, and 17-year-olds less than 1,500 was obtained. Those counties were mapped and near neighbors in the same state and SDOC category were manually aggregated until the total average number of 9's, 13's, and 17's in the group met or exceeded 1,500.

4.4.2 Order Frame

Once the listing units were formed, they were ordered, within each region and SDOC category, in serpentine fashion by state as specified in table 4-4 and alternately within each state by increasing and then decreasing percent minority. The alternating percent minority was obtained by renumbering states using the serpentine order and assigning a negative sign to the percent minority if the state was even. The ordering is illustrated in table 4-5 for the Urban Fringe (SDOC2) in the southeast region (region 2).

The ordering shown in table 4-5 is a final ordering. To obtain a starting point for this final order, listing units within each region and SDOC category were serpentine ordered by state and alternately within each state by increasing and decreasing percent minority. A random number was then selected between 1 and the total sample allocation. In the example, the number was 14.1010 ($1 < 14.1010 < 15$). This number was located in the accumulated allocation and the order began there. For the example, the allocation 14.1010 occurred in the fourth Florida listing unit so the final ordering shown in table 4-5 began there.

Notice in table 4-5 that Louisiana, Kentucky, North Carolina and Florida which are the first third, fifth, and seventh (i.e., odd numbered) states in the region by SDOC category have positive minority indices. Tennessee, Virginia, and Georgia which are second, fourth, and sixth (i.e., even numbered) states have negative minority indices. The alternately

Table 4-5. Illustration of serpentine ordering of sampling frame

State	Primary sampling unit	Serpentine order	Minority index	Sample allocation	Cumulative allocation
Florida	2025	11	38.894	2.1861	2.1861
Alabama	2073	12	-33.928	1.1413	3.3274
Louisiana	2071	2	49.818	1.4128	4.7402
Tennessee	2157	4	-39.160	1.6016	6.3418
Tennessee	2037	4	-22.030	0.7998	7.1416
Kentucky	2111	5	15.802	1.2986	8.4402
Virginia	2760	7	-43.393	0.3989	8.8391
Virginia	3129	7	-31.579	0.5005	9.3396
North Carolina	2119	8	25.104	0.7356	10.0752
Georgia	2121	10	-40.639	1.1972	11.2724
Georgia	2089	10	-15.202	0.7213	11.9937
Florida	2103	11	9.713	0.9045	12.8982
Florida	2031	11	15.464	1.0849	13.9831
Florida	2057	11	24.565	1.0169	15.0000

increasing and decreasing order of the minority indices by state within the serpentine order may be seen by examining Georgia where the index is in decreasing order (ignore sign) and Florida where the order is increasing.

4.4.3 Form Zones

The total five-sample allocation for each region by SDOC category shown in table 4-2 was formed. One-, two-, and three-replicate-zones were formed. Specifically for the region 2 and SDOC2 example of table 4-3, the total five-sample allocation of 15 replicates or 5 single-replicate units and 5 double-replicate units as noted in table 5-2 was apportioned among the primary sampling units in proportion to the adjusted average numbers of 9-, 13-, and 17-year-olds. Adjusted implies that those populations in the oversampled areas were counted twice. This sample allocation and the accumulated allocation are shown in table 4-5.

A total of ten zones were formed for the example consisting of 5 double-replicate zones followed by 5 single-replicate zones. Each double-replicate zone consisted of a sample allocation of 2. Sample allocation was accumulated down the ordered list until a cumulative allocation of 2 was obtained. Thus, the first zone was composed entirely of Florida PSU 2025. Zone 2 consisted of 0.1861 of Florida PSU 2025, all of Alabama PSU 2073 whose allocation was 1.1413, and 0.6726 replicates of Louisiana PSU 2071. Zone 2 then contained a sample allocation of 2 (0.1861 + 1.1413 + 6726). The remainder of the Louisiana PSU 2071 (i.e., .7402 = 1.4128 - 0.6726) was included in zone 3. This procedure continued until 5 double-replicate zones were formed. The total allocation to these zones was 10 (5 x 2) and they included all units through North Carolina PSU 2119 except for 0.0752 of the North Carolina unit. From each zone these formed, one unit (either a single-, double-, or triple-replicate unit) was selected.

The specific algorithm for selecting these units is described in section 6. The units were selected with probability proportional to the adjusted numbers of 9-, 13-, and 17-year-olds.

The 0.0752 of the North Carolina unit as well as the 5 units at the end of the list were formed into 5 single-replicate zones using the procedure described in the previous paragraph except the cumulative sample allocation used to define a zone was 1 instead of 2. Thus, the first single-replicate zone consisted of 0.0752 of North Carolina PSU 2119 and 0.9248 of Georgia PSU 2121. The remainder of the Georgia PSU 2121 (i.e., 0.2724 = 1.1972 - 0.9248) was included in single-replicate zone 2.

When the region by SDOC allocation consisted of double- and triple-replicates, the double-replicate zones were formed first followed by the triple-replicate zones.

4.4.4 Select Sample

For the example of table 5-5, a 2-replicate unit was selected from each of the 5 double-replicate zones, and a 1-replicate unit was selected from each of the 5 single-replicate zones. Examining the way the zones wre formed in sectin 5.4.3, the first unit Florida PSU 2025 was assured by being selected in double-repliate zone 1 and had a small probability of being again selected in zone 2. Its probability of being selected in zone 2 was 0.0931 ($\frac{0.1861}{2}$) .

Similarly, North Carolina PSU 2119 was included in both double-replicate zone 5 and single-replicate zone 1. Its probability of being selected in zone 5 was 0.3300 [(.7352 - .0752)/2] and in zone 1 was 0.0752 ($\frac{.0752}{1}$).

4.4.5 Assign Selected Units to Years

The entire five sample allocation was selected and assigned systematically to single samples. The samples were denoted by the numbers 1

through 5 with 1 through 4 signifying Years 11 through 14, respectively, and 5 signifying the replacement and large sample option (called the supplemental year).

After the single units were selected by zone, random permutations of the integers 1 through 5 were repeatedly generated and used to assign the units to years. The assignment is shown in table 4-6 for the example in table 5-5. The first ten selected units are the double-replicate units and the last five are the single-replicates. Florida PSU 2025 was selected twice as were Tennessee PSU 2157 and Kentucky PSU 2111.

Three permutations of the integers from 1 to 5 were generated (i.e., 1-5-3-4-2, 5-2-3-4-1, and 4-3-1-2-5) to assign the selected units to years. Thus, Florida PSU 2025 was assigned to Years 1 and 5, Alabama PSU 2073 was assigned to Year 3, Louisiana PSU 2071 was assigned to Year 4, and Tennessee PSU 2157 was assigned to Year 2. This procedure was continued to assign the remaining selected units to years.

When a unit was selected for more than one year, control was not exercised to insure balance between years. The assignment was said to be balanced if all units were assigned to different years when at most five units were selected, if at most 2 units were assigned per year when between 6 and 10 units were selected; and if at most 3 units were assigned per year when between 11 and 15 units were selected. After the sample was selected, the number of multiply selected units were enumerated and reassigned to years to make the assignment balanced.

Table 4-6. Assignment of selected units to years

State	Primary sampling unit	Sample year	Replicate status
Florida	2025	1	2
Florida	2025	5	2
Alabama	2073	3	2
Louisiana	2071	4	2
Tennessee	2157	2	2
Tennessee	2157	5	2
Tennessee	2037	2	2
Kentucky	2111	3	2
Kentucky	2111	4	2
North Carolina	2119	1	2
Georgia	2121	4	1
Georgia	2089	3	1
Florida	2103	1	1
Florida	2031	2	1
Florida	2057	5	1

5. OPTIONS FOR LARGE AND SMALL ANNUAL SAMPLES

When the decision was made in Year 07 for economic reasons to reduce the sample to 75 travel points and 550 schools per age class, it was hoped that full funding would be restored in the future and samples of 1,000 schools per age class could be selected. Prior to Year 07, samples consisted of 216 replicates or about 116 travel points and 1,000 schools per age class which yielded 2,592 responses per package since each session yielded about 12 responses (12 x 216 = 2,592). In Year 07, and all succeeding years, the number of replicates was reduced to 162 thereby decrementing the number of travel points to 75 and decreasing the numbers of schools to 500 per age class. A total of 2,592 responses per package were still obtained since the number of respondents per session was increased to 16 (16 x 162 = 2,592). The Year 11 4-year primary sample was designed to accommodate either 75 PSUs and 550 schools per age class or 100 PSUs and 1,000 schools per age class. This objective was met by defining a fifth primary sample which could be used for the dual purposes of (1) augmenting the 75 PSU primary sample to 100 PSU level or (2) providing replacement PSUs for those which refuse. The supplemental sample is used to identify replacement PSUs for those refusing by locating the PSU selected from the same zone as the refusing one. The remainder of this chapter explains how the supplemental sample is used to augment the sample to the 100 PSU level.

5.1 Primary Sample

In order to increase an annual four-year primary sample to 100 PSUs, the supplemental sample is partitioned into 4 subsamples. The subsamples are then randomly assigned to the 4 years.

Subsamples are balanced with respect to number of PSUs, number of replicates, and regional and SDOC allocations. One such partitioning is shown in table 5-1. Here the total replicates of 162 is partitioned into 3 sets of 41 and 1 set of 39. The total number of 83 PSUs is partitioned into 3 sets of 21 and 1 set of 20. The sample allocation in terms of 1-, 2- and 3-replicate units is also depicted in the table for each subsample.

Thus, if subsample 2 was selected to augment a particular annual sample, the total number of PSUs would be 104 (83 + 21), the total number of replicates would be 203 (162 + 41); and the total number of 1-, 2-, and 3-replicate units would be 10 (8 + 2), 89 (71 + 18), and 5 (4 + 1), respectively.

5.2 Secondary Sample

If the 75 PSU option is elected, the total number of schools selected per age class would be about 550. For the 100 PSU option, approximately 1,000 schools per age class would be selected. The total numbers of schools for each age would be apportioned among the PSUs in proportion to the replicate status of the PSU. The school sample would be selected adhering as closely as possible to this allocation.

As noted earlier, PSU's were formed so as to contain a minimum of 1,500 age class eligibles. This number of eligibles can accommodate the selection of either 550 or 1,000 schools per age class. Table 5-2 compares the numbers of schools selected per replicate and per PSU under each option.

Table 5-1. Partitioning supplemental samples into 4 subsamples

Region	SDOC	Subsamples 1			2			3			4			Total		
		1-rep	2-rep	3-rep	1-rep	2-rep	3-rep	1-rep	2-rep	3-rep	1-rep	2-rep	3-rep	1-rep	2-rep	3-rep
1	1	-	2	1	-	1	-	-	1	-	-	1	-	0	5	1
	2	-	-	-	-	1	1	-	1	-	-	1	-	0	3	1
	3	-	2	-	-	2	-	-	1	-	-	1	-	0	6	0
	6	1	-	-	-	-	-	-	1	-	-	1	-	1	2	0
	7	-	-	-	1	-	-	-	-	-	-	-	-	1	0	0
	Subtotal	1	4	1	1	4	1	0	4	0	0	4	0	2	16	2
2	1	-	1	-	-	1	-	-	1	-	-	-	-	0	3	0
	2	-	-	-	-	-	-	1	-	-	-	1	-	1	1	0
	3	-	2	-	-	1	-	-	1	-	-	1	-	0	5	0
	4	-	1	-	-	2	-	-	2	-	-	1	-	0	6	0
	5	-	1	-	-	-	-	-	-	-	1	1	-	1	2	0
	Subtotal	0	5	0	0	4	0	1	4	0	1	4	0	2	17	0
3	1	-	1	-	-	2	-	-	2	-	-	2	-	0	7	0
	2	-	1	-	-	1	-	-	-	1	-	-	-	0	2	1
	3	-	1	-	-	1	-	-	2	-	-	1	-	0	5	0
	4	1	-	-	-	1	-	-	1	-	-	1	-	1	3	0
	5	-	1	-	-	1	-	-	1	-	-	1	-	0	4	0
	Subtotal	1	4	0	0	6	0	0	6	1	0	5	0	1	21	1
4	1	-	2	-	-	2	-	-	2	-	-	2	1	0	8	1
	2	-	-	-	1	-	-	-	-	-	-	1	-	1	1	0
	3	-	2	-	-	1	-	-	1	-	-	1	-	0	5	0
	4	-	1	-	-	1	-	1	-	-	-	-	-	1	2	0
	5	-	-	-	-	-	-	-	1	-	1	-	-	1	1	0
		0	5	0	1	4	0	1	4	0	1	4	1	3	17	1
Total		2	18	1	2	18	1	2	18	1	2	17	1	8	71	4
Total PSUs			21			21			21			20			83	
Total Replicates			41			41			41			39			162	

Table 5-2. Numbers of schools per replicate and per PSU for each option

	550 schools and 75 travel points	1000 schools and 100 travel points
Number of replicates	162	162 + 162/4 = 202.5
Number of schools	550	1000
Number of schools/replicate	3.40	4.94
Number of PSU's	83	83 + 83/4 = 103.75
Number of schools	550	1000
Number of schools/PSU	6.63	9.64

6. SELECTION TECHNIQUES

A stratified probability proportional-to-size selection technique was employed to select the sample. The size measure was the variable OVERSIZE as defined in section 3.2. The alogrithm for sample selection is described by Chromy (1979).

7. SPECIAL POPULATIONS

When the coordinated four-year primary sample was selected in Year 11, there was concern that over the period of four years the sample might need to be directed toward certain minority populations. Requests had already been received to report data separately for Hispanics, and a special report was prepared by NAEP for this purpose by aggregating data across exercises and reporting mean values. At one time the option to include Miami in the four-year sample with certainty was considered to ensure a sample size adequate to report Hispanic data separately by exercise. This idea was rejected because a more general solution to the minority population problem was desired. At the time, the interest was in Hispanics but it was felt that over the period of four years interest might shift to Asians or Indians. Enough Black responses are obtained to report exercise-level data for the Black subpopulation.

To solve the minority problem, it was decided to include on the frame, county-level counts of numbers of Asians, Blacks, Hispanics, and Indians. These counts were obtained from 1970 Census data as described in section 3.2 of this report (see ASIANPOP, ASIZE, BLACKPOP, BSIZE, HISPOP, HSIZE, and INDIAN, ISIZE). The sample was selected after the frame was stratified by percent minority which is a combination of all the races listed above. The stratification of the frame is explained in section 4. The purpose of the stratification was to balance the allocation of minority population to annual samples.

Table 7-1 was prepared to display the weighted estimates of each type of minority population included in each annual sample and the supplemental

sample. Estimates are included for average numbers of 9-, 13-, and 17-year-olds, Asian population, Hispanic population, Indian population, Black population, and adjusted numbers of 9-, 13-, and 17-year-olds. Estimates were computed by determining the weights for each PSU and then summing the cross product of the weight and the estimate across all PSU. Adjusted 9-, 13-, and 17-year-olds were also included to verify each sample. The adjusted estimate was computed by counting the oversampled population in each primary sampling unit twice. The adjusted estimate should be constant from sample-to-sample. The arithmetic mean, standard error, relative standard error, maximum, and minimum estimate by type of population are also included in the table. The relative standard error is the ratio of the standard error to the arithmetic mean. The frame (or true) value was obtained by summing the estimate over the entire frame.

Tables 7-2 through 7-7 list weighted estimates of the minority populations by region and SDOC category for each annual sample, the supplemental sample, and the frame. The adjusted numbers of 9-, 13-, and 17-year-olds for each region and SDOC category are constant from sample-to-sample and for the frame as they should be. It was noted that the supplemental sample region 4 and SDOC4 category contained unusually high Asian and Indian populations. Further investigation revealed that the large numbers arose because the Alaska Balance was selected from the region by SDOC category.

Table 7-1. Weighted estimates of minority populations from 4-year primary sample

Year	Average 9,13,17	Asian population	Hispanic population	Indian population	Black population	Adjusted 9,13,17
11	3,881,371	16,372	209,609	23,618	349,341	4,315,927
12	3,875,897	65,391	239,268	8,363	415,444	4,315,928
13	3,869,251	21,181	210,931	19,345	439,770	4,315,928
14	3,858,330	17,963	157,046	23,900	421,680	4,315,928
Supplemental	3,862,196	34,111	184,294	15,980	388,742	4,315,927
$\bar{x}$	3,869,409	31,004	200,230	18,241	402,995	4,315,928
s	9,487	20,450	31,005	6,419.5	35,137	0
RSE	.25%	66%	15%	35%	9%	0%
Frame Value	3,868,400	28,040	203,983	16,791	413,643	4,315,926
Maximum	3,881,371	65,391	239,268	23,900	439,770	-
Minimum	3,858,330	16,372	157,046	8,363	349,351	-

Table 7-2. Weighted estimates of minority populations by region and SDOC for Year 11

Region	SDOC	Average 9,13,17	Asian population	Hispanic population	Indian population	Black population	Adjusted 9,13,17
1	1	259,735	1516.40	24322.2	274.9	61664	337,519
1	2	231,294	633.47	1973.0	216.9	18572	231,294
1	3	321,465	700.08	5930.6	446.9	15604	321,465
1	6	125,811	133.50	750.4	260.7	2907	125,811
1	7	11,689	5.56	57.5	4.8	3050	23,377
2	1	144,411	241.54	12809.6	183.4	22520	171,171
2	2	90,010	321.39	1977.0	76.1	8699	90,010
2	3	272,331	414.42	3619.8	400.1	34945	272,331
2	4	314,151	312.93	3471.2	259.4	33661	314,151
2	5	62,495	36.30	1335.3	25.5	15735	124,989
3	1	321,024	1188.67	9132.4	560.7	53800	382,934
3	2	186,151	320.53	3890.1	124.3	4583	186,151
3	3	268,679	312.92	3266.1	262.0	13084	268,679
3	4	188,897	147.36	5439.8	135.1	800	188,897
3	5	105,705	56.47	925.3	603.9	431	211,410
4	1	449,542	6770.77	79838.6	4191.1	39409	496,084
4	2	78,696	174.62	7147.9	181.4	2374	78,696
4	3	268,835	2582.30	24972.3	986.4	13090	268,835
4	4	138,779	455.26	17510.0	13448.8	3837	138,779
4	5	41,672	47.75	1240.1	975.4	580	83,343

Table 7-3. Weighted estimates of minority populations by region and SDOC for Year 12

Region	SDOC	Average 9,13,17	Asian population	Hispanic population	Indian population	Black population	Adjusted 9,13,17
1	1	258,233	1355.3	13187.5	404.15	53580	337,519
1	2	231,294	821.7	3164.9	105.53	4931	231,294
1	3	321,465	726.5	7841.5	175.99	11600	321,465
1	6	125,811	151.4	700.6	67.30	766	125,811
1	7	11,689	5.5	109.4	8.30	51	23,377
2	1	133,150	347.5	2591.5	94.94	34666	171,171
2	2	90,011	64.8	868.7	63.70	1913	90,011
2	3	272,331	813.0	4126.6	254.75	49728	272,331
2	4	314,151	269.4	2711.3	209.16	107567	314,151
2	5	62,495	51.4	342.1	24.63	27210	124,989
3	1	326,457	1005.8	7767.4	656.15	49925	382,934
3	2	186,151	228.2	5404.4	198.43	6041	186,151
3	3	268,679	570.1	4385.9	586.11	10530	268,679
3	4	188,897	213.8	2141.6	354.68	7833	188,897
3	5	105,705	50.8	1623.2	141.51	146	211,410
4	1	451,396	35387.5	77803.7	1414.03	33498	496,084
4	2	78,696	734.3	4154.4	149.50	1329	78,696
4	3	268,835	2374.8	67873.3	1359.99	11048	268,835
4	4	138,779	19991.7	23704.7	1747.92	1607	138,779
4	5	41,672	227.3	8765.5	346.25	1473	83,343

Table 7-4. Weighted estimates of minority populations by region and SDOC for Year 13

Region	SDOC	Average 9,13,17	Asian population	Hispanic population	Indian population	Black population	Adjusted 9,13,17
1	1	260,795	2612.24	25049.8	343.7	67332	337,519
1	2	231,294	505.33	3877.5	362.3	12938	231,294
1	3	321,465	694.12	7560.9	227.5	16793	321,465
1	6	125,811	184.45	875.5	252.4	7593	125,811
1	7	11,689	5.06	36.0	2.8	42	23,377
2	1	149,818	174.22	2447.5	77.6	28999	171,171
2	2	90,011	158.20	2969.2	73.7	8139	90,011
2	3	272,331	298.90	2717.0	218.6	54857	272,331
2	4	314,151	154.22	2133.5	118.7	72166	314,151
2	5	62,495	40.01	438.3	25.6	25275	124,989
3	1	316,294	1168.69	8992.0	469.9	66505	382,934
3	2	186,151	406.36	2560.2	137.6	2346	186,151
3	3	268,679	343.79	3552.1	456.8	17399	268,679
3	4	188,857	120.67	2542.1	339.4	602	188,897
3	5	105,705	59.43	958.8	344.8	2498	211,410
4	1	435,683	9909.98	68027.1	2960.9	37702	496,084
4	2	78,696	240.65	4238.1	214.3	2121	78,696
4	3	268,835	2975.73	57958.3	1608.3	7656	268,835
4	4	138,779	901.58	9122.9	10722.8	8707	138,779
4	5	41,672	226.99	4874.6	387.0	101	83,343

Table 7-5. Weighted estimates of minority populations by region and SDOC for Year 14

Region	SDOC	Average 9,13,17	Asian population	Hispanic population	Indian population	Black population	Adjusted 9,13,17
1	1	266,987	1791.92	14911.7	304.70	57274	337,519
1	2	231,294	956.23	4214.4	208.37	18508	231,294
1	3	321,465	606.98	4852.1	169.50	17157	321,465
1	6	125,811	104.28	1359.0	67.35	4650	125,811
1	7	11,689	5.13	133.9	2.53	29	23,377
2	1	127,817	205.95	3100.0	85.94	39945	171,171
2	2	90,011	32.41	349.2	62.22	6845	90,011
2	3	272,331	384.25	3476.7	194.12	50390	272,331
2	4	314,151	185.48	2643.3	1342.06	89035	314,151
2	5	62,495	25.01	787.7	35.10	10008	124,989
3	1	331,551	1168.37	8529.7	482.80	50335	382,934
3	2	186,151	311.81	5199.0	210.72	3525	186,151
3	3	268,679	335.04	3633.4	284.83	13244	268,679
3	4	188,897	368.39	1486.4	440.14	1227	188,897
3	5	105,705	53.97	783.9	4659.80	104	211,410
4	1	425,316	5500.28	65758.4	1878.37	38993	496,084
4	2	78,696	1068.30	5970.1	212.05	3956	78,696
4	3	268,835	4334.46	24836.8	2111.19	11360	268,835
4	4	138,779	495.06	3064.5	9689.50	2504	138,779
4	5	41,672	29.27	1955.6	1458.95	2592	83,343

Table 7-6. Weighted estimates of minority populations by region and SDOC for supplemental year

Region	SDOC	Average 9,13,17	Asian population	Hispanic population	Indian population	Black population	Adjusted 9,13,17
1	1	270,016	1032.5	19009.8	355.56	51597	337,519
1	2	231,294	559.8	2448.8	143.39	9828	231,294
1	3	321,465	584.1	4452.4	171.47	15822	321,465
1	6	125,811	114.7	1153.0	84.68	1087	125,811
1	7	11,689	5.6	57.5	4.77	3050	23,377
2	1	138,835	273.5	17592.0	113.03	29431	171,171
2	2	84,503	412.8	1359.8	87.53	13263	90,011
2	3	272,331	497.6	2857.1	145.80	77907	272,331
2	4	314,151	349.9	3842.5	165.40	27350	314,151
2	5	62,495	22.5	877.0	73.61	13415	124,989
3	1	324,674	1294.4	8623.5	646.23	55777	382,934
3	2	186,151	351.3	2198.7	119.84	3897	186,151
3	3	268,679	294.5	6208.6	231.85	10889	268,679
3	4	188,897	131.0	1587.2	126.84	770	188,897
3	5	105,705	73.9	698.9	635.03	940	211,410
4	1	427,519	9788.3	64153.0	1630.76	48193	496,084
4	2	78,696	1687.4	6300.7	1897.30	3472	78,696
4	3	268,835	2579.7	18515.1	2616.87	17467	268,835
4	4	138,779	14019.9	7547.3	6652.52	4093	138,779
4	5	41,672	37.9	14810.9	77.56	495	83,343

Table 7-7. Weighted estimates of minority populations by region and SDOC for frame

Region	SDOC	Average 9,13,17	Asian population	Hispanic population	Indian population	Black population	Adjusted 9,13,17
1	1	264,007	1835.4	21168.2	337.16	58845	337,519
1	2	231,294	761.0	3457.4	177.57	11329	231,294
1	3	321,465	722.6	6226.2	250.84	14883	321,465
1	6	125,811	166.0	877.0	192.96	3005	125,811
1	7	11,689	5.5	74.0	4.34	823	23,377
2	1	136,765	315.1	8146.7	113.91	32985	171,171
2	2	89,031	203.2	1590.4	83.49	10406	90,011
2	3	272,331	446.4	3443.5	349.77	56228	272,331
2	4	314,151	236.7	3180.8	1031.12	65559	314,151
2	5	62,495	31.1	782.8	101.91	17724	124,989
3	1	323,019	1224.1	8776.9	585.34	56826	382,934
3	2	186,151	328.4	3298.3	178.05	5700	186,151
3	3	268,679	459.6	4825.7	530.27	13872	268,679
3	4	188,897	174.3	2573.5	823.70	2735	188,897
3	5	105,705	58.3	885.5	817.85	476	211,410
4	1	438,930	16394.0	67886.1	2361.36	39964	496,084
4	2	78,696	776.2	6626.1	559.13	3188	78,696
4	3	268,835	2832.0	38010.0	1793.20	11303	268,835
4	4	138,779	981.4	15593.4	5561.80	6208	138,779
4	5	41,671	88.7	6560.3	937.07	1586	83,343

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